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Saville, Christopher; Handley, Claire; Oakley, David

Journal of Epidemiology and Community Health

Published: 11/06/2020

Peer reviewed version

Residential churn moderates the relationship between economic deprivation and psychiatric admission: evidence from Wales

Claire E. Handley[1,2], David Oakley[2] & Christopher W.N. Saville[1]

Corresponding author: Claire Handley, Conwy CAMHS, Mostyn Suite, Llandudno General Hospital, Hospital Road, Llandudno LL30 1LB.

email: claire.handley@wales.nhs.uk, Telephone: 01492 863377

[1]North Wales Clinical Psychology Programme
School of Psychology, Bangor University
Bangor, Gwynedd
LL57 2DG

[2]Betsi Cadwaladr University Health Board
Ysbyty Gwynedd
Penrhosgarnedd, Bangor, Gwynedd
LL57 2PW

Conflict of interest: None.

Financial support: *This research received no external funding.*

Competing interest: None declared.

Keywords: Social epidemiology; population turnover; mental health; social capital; poverty; residential stability

Acknowledgements: The authors would like to thank Guy Lansley at the Consumer Data Research Centre for his support in accessing the churn dataset.

Word count: 2754

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What is already known on this subject?
Poverty is a risk factor for poor mental health, but there is evidence that strong social capital can help to ameliorate this risk. Social capital can be disrupted in areas with high population turnover, but it is not clear whether this interferes with social capital's proposed positive effects on mental health.

What this study adds?
In areas with high population turnover, poverty is a stronger risk factor for mental health than in more stable areas. This supports a social capital theory of health. Population turnover should be recognised as a mental health risk factor by public bodies with responsibility for public mental health.

ABSTRACT

Background: There is a well-established link between area-level socioeconomic deprivation and psychiatric admission rates. Social capital has been proposed as a possible protective factor that may buffer economically deprived communities, but it may be disrupted in areas with high population turnover. This study aims to test whether population turnover, hereafter called churn, moderates the social gradient of psychiatric admissions.

Methods: Population churn rates, low income rates and psychiatric admission rates for 1909 lower super output areas in Wales were analysed using Poisson generalised linear mixed-effects models. Additional analyses explored the impact of deprivation measured more generally and the potential confound of population density.

Results: Population churn moderated the association between socioeconomic deprivation and psychiatric admission rates, such that greater social gradients in admission rates were found in areas with greater churn. Economic deprivation and churn were also found to be independently positively associated with admission rates. These relationships remained significant when using a broader measure of deprivation and after adjusting for population density.

Conclusion: High churn appears to exacerbate the detrimental effects of economic deprivation on mental health as well as being a risk factor in its own right. Residential stability rates should be considered when designing and implementing policies which aim to understand, prevent and treat mental health problems in at-risk communities.

INTRODUCTION

Socioeconomic deprivation has been shown to be a risk factor for negative mental and physical health outcomes [1]. In the case of mental health, this leads to a social gradient in both common mental health problems [2] and more severe outcomes such as psychiatric admission [3].

One possible buffer against some of the detrimental mental health correlates of deprivation is social capital: connections among individuals and the norms of reciprocity and trustworthiness that arise from them [4]. High cognitive social capital has been shown to be protective against common mental health disorders [5] and several studies have shown that high levels of social capital can ameliorate the association between economic capital and mental health [6–9].

However, social capital can become disrupted in areas with high population turnover because relationships cannot develop to the same degree as in more stable communities [10]. Putnam [4] demonstrated that residential stability was strongly associated with many forms of civic engagement: people who had recently arrived in an area were less likely to vote [11] or to have a supportive network of friends and neighbours [12]. People who intend to move in the near future, or those who were renting, were less likely to take part in community life [12]. Population turnover, hereafter called churn is thus a plausible risk factor for mental health problems.

It is important to ensure any putative relationship between churn and mental health is not better explained by economic deprivation. Evidence suggests that, in the UK at least, this is not the case. According to an analysis of 2001 census data, there is a modest and non-linear relationship between churn and deprivation, which varies regionally [13]. That said, it

is important to address whether any predictive value churn has as a risk factor is independent of economic deprivation's well-documented predictive value.

Although churn does not appear to be redundant with economic deprivation, it may be a proxy for specifically urban poverty, or indeed urbanicity more broadly. Urbanicity is itself a risk factor for mental health problems, psychosis in particular [14], which can in turn lead to more admissions [15].

This study aims to explore whether churn, as a potential disrupter of social capital, moderates the association between economic deprivation and inpatient admissions. We conjecture that in areas with low economic capital, social capital is particularly important in protecting residents from adverse life events. Thus in areas that lack both forms of capital we expect to see a super-additive increase in psychiatric admissions. We also assess whether churn is an independent risk factor for psychiatric admission rates, after accounting for economic deprivation, and whether any moderation remains after adjusting for urbanicity.

METHOD

Ethics

Ethics was granted from university and NHS Research Ethics Committees. The Consumer Data Research Centre (CDRC) granted permission to access and use the safeguarded churn data.

Data Sources

Data were analysed at lower-layer Super Output Area (LSOA) level. LSOAs are areas designed using UK Census data to improve the reporting of small area statistics in England and Wales. These geographical areas, of which there were 1909 in Wales following the 2011

census, have a mean population of 1500 individuals with no LSOA containing less than one thousand people (Office of National Statistics, 2011)..

Churn data [10] were provided by the CDRC. The churn index is an estimate of the proportion of households that have changed occupancy between the end of 2016 and the start of each year going back to 1998, based on administrative and consumer data including consumer registers, land registry house sale data and electoral registers. In this study, the interval between 2012 and 2016 was used to operationalise churn. This year was chosen somewhat arbitrarily but sensitivity analyses were conducted to check any relationships were robust. Using other reference years yielded similar results to those described in the results section (the relationship between churn and admission rates and the interaction between churn and deprivation on admission rates, see below) and 2012 had a high correlation coefficient with years 2007-2013 (r>0.9).

Admission counts for each LSOA were derived from the 2017 data from the Patient Episode Database for Wales, which includes inpatient and day-patient admission data for all seven health boards in Wales. Counts of individual patients (*i.e.* each patient was counted only once) admitted from each LSOA with a psychiatric treatment code (under the Office of Population Censuses and Surveys Classification of Interventions and Procedures), stratified by sex and age (in three bands: 18-34, 35-65 and 65+), were computed for each LSOA. Admissions with missing data for age(no missing data), sex (.0002% missing data), or LSOA (.0064% missing data) were excluded.

The measure for economic deprivation was the percentage of the population in each LSOA in receipt of low-income related benefits according to the data used in the Welsh Index of Multiple Deprivations (WIMD) [16] an official measure of poverty. This is defined as those who are either: (a) an adult, or dependent child of an adult, in receipt of income

related benefits; (b) an adult, or dependent child of an adult, in receipt of Working and Child Tax Credits, with income less than 60 per cent of the Wales median; or (c) an Asylum Seeker.

The overall deprivation rating from the WIMD for each LSOA was used in a control analysis to assess the impact of relative deprivation more generally. Each LSOA was ranked in terms of their level of deprivation from most to least deprived according to a weighted sum of eight domains: access to services, education, employment, health, housing, income, physical environment and safety. Within this ranking, income rating was weighted at 25.3%.

Analysis

To test the interaction of economic deprivation and churn on admission rates, a Poisson generalised linear mixed-effects model was fitted to the data using the *glmer* function in the *lme4* package [17] for R [18].Stratified count data of admissions for each LSOA was the dependent variable, with logged population at the given stratum included as an offset to model admissions as a rate. Fixed effects were included for the percentage of the LSOA population on low pay, level of churn, and their interaction (all z-scored). Sex, Age, Local Authority and LSOA were modelled as random effects, to account for non-independence of data and, in the case of local authority, to control for local differences in practice and policy which may also effect admission rates. To test for significance, *p*-values of the slopes were compared to an alpha of .05.

Control Analyses

To test whether any relationship between churn and admission rates was an artefact of urbanicity, a further analysis was run to control for population density. Density data was derived from the 2011 census [19]. Population density and its two and three-way interactions with low pay and churn were added to the main model.

A second control analysis substituted low pay data with the WIMD rank of deprivation to measure deprivation more broadly.

RESULTS

Descriptive analysis

There were 10,454 individuals admitted to inpatient wards in 2017. The range of admissions for each LSOA ranged between 0 and 15. The percentage of residents in receipt of low pay related benefits ranged from 1% to 63% with a median of 14%, a mean of 16.09%, and a standard deviation of 9.6%. The rate of churn ranged from 15% to 72%, with a median of 29%, a mean of 30%, and a standard deviation of 6%. The maps shown in Figure 1 display rates of low pay, churn and admissions for LSOAs across Wales. There is substantial overlap between low pay and admission rates (ρ=.46) with high rates of both on the north coast, South Wales Valleys, Swansea, and Wrexham (with a lower spatial frequency for admission rates than low pay). Churn, conversely, had only a modest positive relationship with low pay (ρ=.14) and admission (ρ=.15) rates, being focused in and around university towns.

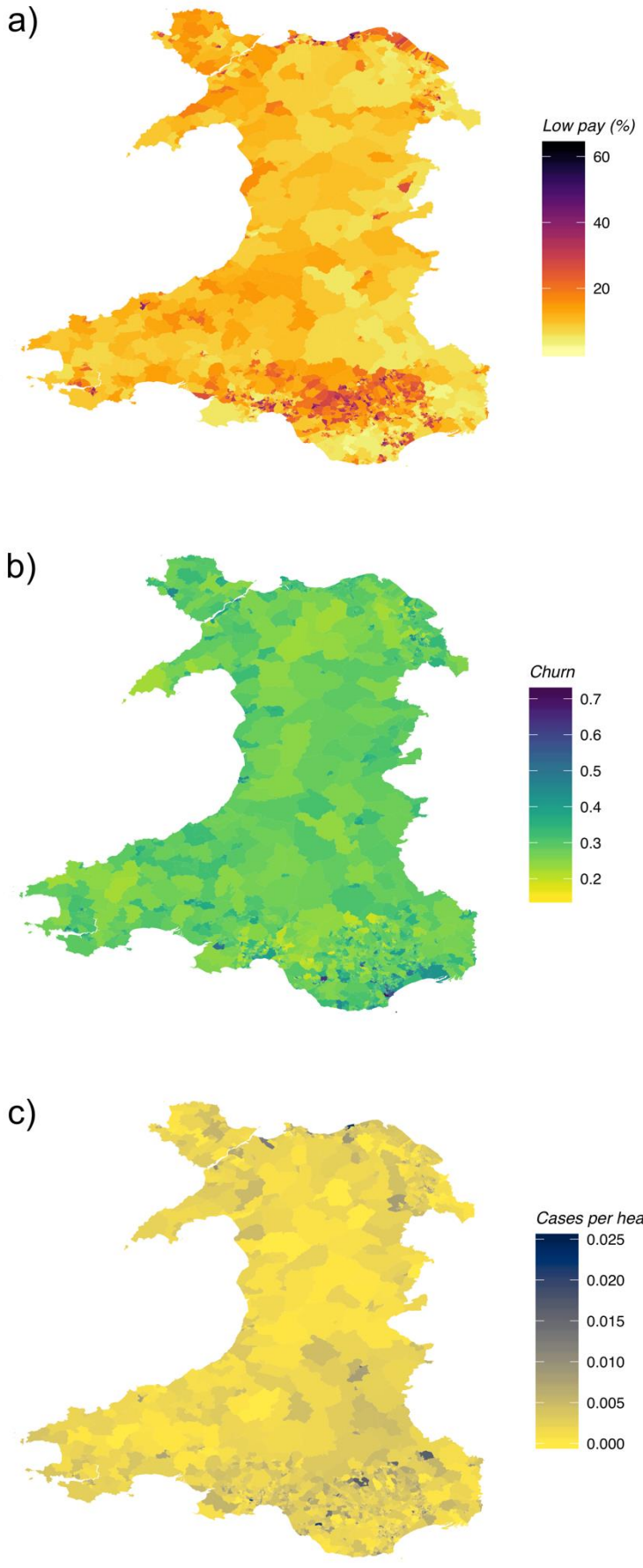
a)
Low pay (%)
60
40
20
b)
Churn
0.7
0.6
0.5
0.4
0.3
0.2
c)
Cases per head
0.025
0.020
0.015
0.010
0.005
0.000

Figure 1: Maps of a) percent on low pay, b) churn and c) admission cases per head of population across the LSOAs in Wales. Darker colours indicate higher rates.

Regression analysis

LSOAs with higher rates of low pay had higher rates of admission (risk ratio [RR]=1.325 [$CI^{95\%}$:1.290-.1.361], all RRs for 1 Standard deviation increase in exposure). High churn was also associated with higher admission rates, but less strongly (RR=1.064 [$CI^{95\%}$:1.033-1.097]). The interaction between churn and low pay was statistically significant, with super-additively higher admission rates in areas with high churn and high rates of low pay (RR=1.057 [$CI^{95\%}$:1.029-1.086], Table 1).

Concretely, the model predicts that areas in the lowest deprivation quartile have similar mean admission rates of .28% in the lowest churn quartile and .26% in the highest churn quartile. In the highest deprivation quartile, however, areas in the lowest quartile have mean admission rates of .54% but high churn areas have rates of .68%. These figures look very similar to the actual rates presented in Figure 2.

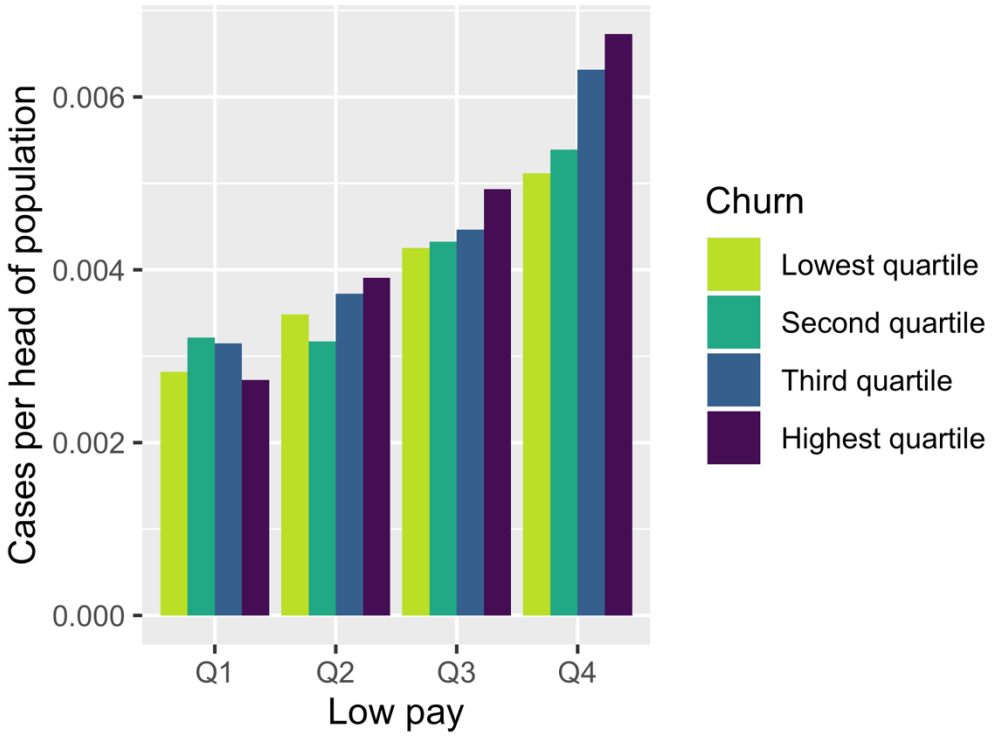

Figure 2. Mean number of admitted cases, split by low pay quartiles (1-8%, 8-14% 14-22%,, and 22-63%) and churn quartiles (15-27%,.27-29%, 29-33%, and 33-72%).

Table 1. Mixed models results.

Term	Coefficient for fixed effects/ variance of random effects	SD	SE	Z value	*p* value
Random effects					
LSOA	0.145	0.380			
Local Authority	0.017	0.129			
Age	0.024	0.154			
Sex	0.006	0.077			
Fixed effects					
Intercept	-5.576		0.109	-51.173	<0.001
Percentage on low-pay	0.281		0.014	20.597	<0.001
Churn since 2012	0.062		0.015	4.077	<0.001

Interaction between income and churn	0.056	0.014	4.107	<0.001

Using overall WIMD rank rather than low pay data showed similar results. LSOAs with deprivation ranks closer to zero, indicating greater deprivation, had higher admission rates (RR=.743 [$CI^{95\%}$:721-.764], p<.001; RR below 1 as data ranked). High churn was also associated with admissions in this model (RR=1.041 [$CI^{95\%}$:1.011-1.073], p=.007). The interaction between these two factors was again statistically significant (RR=.943 [$CI^{95\%}$:.918-.970], p<.001).

Correlations between fixed effects showed no evidence of multicollinearity. The DHARMa package for R [20] was used to check for over/under-dispersion of residuals and zero inflation, neither of which were problematic. However, exploring the scaled residuals suggested that the model slightly underestimated higher observed values. This may be due to outlying LSOAs being influenced by non-modelled factors.

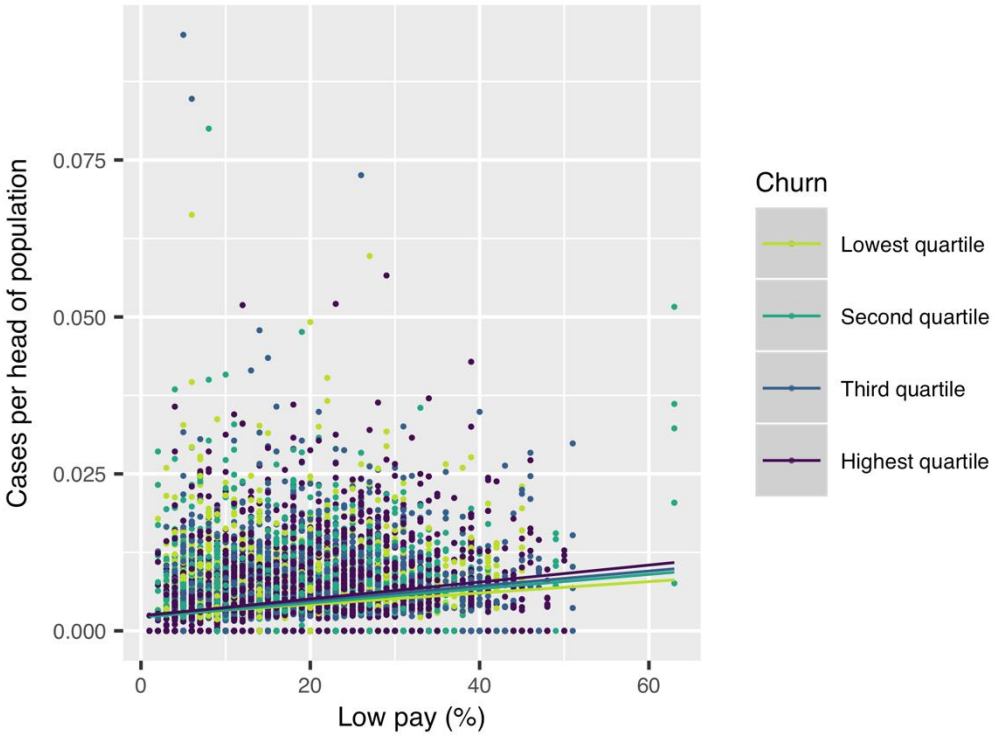

Figure 3. Admission cases by percent of LSOA on low pay split by churn quartiles with linear regression lines.

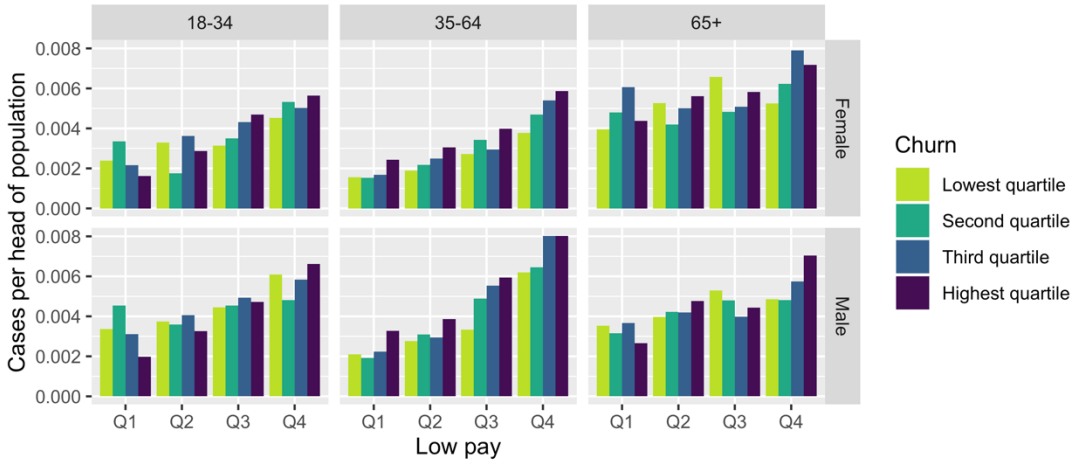

Figure 4. Mean number of admitted cases, split by low pay quartiles (1-8%, 8-14% 14-22%,, and 22-63%) and churn quartiles (15-27%,.27-29%, 29-33%, and 33-72%), separately for each demographic stratum.

There is clear and striking evidence of moderation of the association between deprivation and admission rates by churn. Social gradients are steeper in LSOAs with greater churn with a dose-response relationship of churn. Although the pattern is clearer in the overall data than in individual strata, there is no evidence that the effect is driven only by specific strata. The significant interaction suggested that this relationship was interactive rather than just additive. Churn was also independently positively associated with admissions rates.

As it is plausible that churn is a proxy for urbanicity, which itself is a risk factor for admissions, an analysis was run to determine if churn was still significant when population density was controlled for. The model included both a main effect of density and interactions with low pay and churn.

This model found that the interaction between churn and low pay remained statistically significant after accounting for population density and its interactions (RR=1.049 [$CI^{95\%}$:1.0180–1.081], p=.002). Churn remained predictive of admissions (RR=1.061 [$CI^{95\%}$:1.027–1.095], p<.001). Low pay rates also remained predictive after accounting for population density (RR=1.312 [$CI^{95\%}$:1.274–1.350], p<.001). High density was, as expected, associated with higher admission rates (RR=1.056 [$CI^{95\%}$:1.016–1.096], p=.006).

DISCUSSION

This study found that churn moderated the relationship between economic deprivation and psychiatric admission rates. The moderation showed a very clear dose-response relationship, such that the social gradient in admissions became increasingly steep with increasing churn. Churn and deprivation were also both independently positively associated with admission rates.

Proposed mechanisms

The major implication of these findings is that residential stability is a protective factor for public mental health, which is particularly important in more economically deprived communities. This is consistent with churn being disruptive to social capital by inhibiting its formation and maintenance. Churn could influence a variety of manifestations of social capital: it could prevent group norms from developing, it could prevent trust from being established if people do not really get to know each other, it may reduce incentives to make connections and volunteer locally if residents do not stay long-term.

High churn's potentially disruptive effect on social capital seemed to be particularly detrimental to deprived communities. A possible reason for this may be that at times of crisis (e.g. losing a tenancy) either economic or social capital can help to solve or ameliorate the problem (renting another property or staying with a friend). However for people without either resource, such crises can be overwhelming and life-changing. Thus the super-additive nature of the interaction on poor mental health outcomes.

Limitations

Firstly, although we propose that churn's association with admission rates and its moderation of their social gradient is due to its disruption of social capital, it is important to

acknowledge that we were not able verify that this was the mechanism. It may be that churn is a proxy for unidentified processes other than those associated with social capital.

Secondly, the direction of causality could not be ascertained. It could be that people with mental health problems or financial difficulties may need to move more often, thereby leading to higher levels of churn. Longitudinal studies may be helpful to ascertain which processes may be primary.

Thirdly, as churn and deprivation measures were measured at the area level, we are vulnerable to the ecological fallacy – the association we observe on the aggregated area level may not reflect the associations on an individual level.

Fourthly, we have measured churn as a single construct, but in different areas it may reflect quite different processes, such as gentrification, social drift, life-stage transition, or international migration. The dominant drivers of migration within a given neighbourhood, influenced by issues of power, class and ethnicity/race [21], might moderate its impact on social capital and mental health.

Strengths

As well as these limitations, the study had important strengths. Firstly, we used data from an entire country. This both gave us high statistical power, but also captured a diverse range of neighbourhoods that would not be possible with a smaller, more homogenous area of study. Secondly, we ran control analyses using both other measures of deprivation and a plausible confounding variable – population density. In the latter analysis we also included density's interactions with the other variables of interest, and as such this was a particularly strong test of our proposed moderation. Thirdly, we used mixed effects models to address non-independence of data and demographic stratification, but also local variation in clinical

practice and local government. There is variability in provision in healthcare and social services across Wales, due to the patchwork of seven local health boards and 22 local authorities providing services, and indeed specific health staff, whose patches are often coterminous with local authority boundaries. The presence or absence of other services, plus variability in local clinical decision-making around admission may also determine local admission rates, thus accounting for these administrative boundaries is important.

Future research

Future work could build on this by examining these factors at an individual level, and with longitudinal designs, to test the mechanisms and direction of causation proposed here. It would also be interesting to use other outcome measures, such as self-rated mental health and wellbeing, or less serious mental health difficulties than those experienced by most inpatients. In addition, more research is needed into the efficacy and cost-effectiveness of social capital interventions such as provision of social infrastructure in high churn areas.

Conclusions

This study explored the relationships between population churn, economic deprivation and inpatient admissions in Wales. A large dataset analysed at the LSOA level revealed a striking moderation of the social gradient in psychiatric admission by churn. This finding has implications for agencies who aim to ameliorate the risk factors associated with mental health difficulties and admissions, as areas with both high churn and high deprivation may require additional resources. Research suggests that social capital can support well-being independently and act as a buffer against deprivation to protect mental

health. Therefore, by helping individuals create social networks in high churn environments, such interventions may reduce the detrimental impacts of deprivation and have far-reaching psychological benefits.

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